REMARKS

This is in response to the Office Action mailed January 13, 2003. Claims 1-34 are now pending in this application. New Claims 31-34 have been added to further claim the invention. Claims 1 and 16 have been amended as is further discussed below.

A Supplemental Information Disclosure Statement pursuant to 37 C.F.R. §§ 1.56, 1.97 and 1.98, copies of the documents cited in the Information Disclosure Statement, a Form PTO-1449 listing the documents, and the fee under 37 C.F.R. 1.7(p) are enclosed.

Claims 1-30 have been rejected under 35 U.S.C. § 102(b) as anticipated by "*Brazing Thin Sheet Structures of Titanium Alloys...*" (Kalin). According to the Examiner, Kalin discloses the use of thin sheet structures of titanium and its alloys in brazing (Official Action, p. 2, lines 8-10). The Examiner further takes the position that the disclosure of Parker meets the limitations recited in the Claims 1-30.

However, it is respectfully submitted that Claims 1-30 are not anticipated by Kalin. Claim 1 is directed to a titanium aluminide structure, and Claim 16 has been amended to recite that a titanium aluminide structure is formed. It is respectfully submitted that the amendment to Claim 16 is supported by the specification as originally filed (*see, e.g.*, p. 4, line 14 – p. 5, line 1 of the Specification, and Claim 1) and therefore does not constitute new matter. Claims 1 and 16 have been further amended to recite that the foil contains copper, titanium, zirconium and optionally nickel. In contrast, as also acknowledged by the Examiner, Kalin describes brazing using titanium and its alloys (*see, e.g.*, Title and first sentence of Kalin). It is respectfully submitted that it is well understood by persons skilled in the art that a titanium aluminide differs from a titanium alloy. In particular, it is well known in the art that a titanium aluminide represents an example of <u>intermetallic</u> compounds, also known in the art as

intermetallic alloys (emphasis added). In contrast, it is readily understood by one skilled in the art that Kalin describes conventional titanium-based alloys. Kalin does not disclose or suggest intermetallic compounds or intermetallic alloys. It is well known in the art that intermetallic compounds or intermetallic alloys, including those containing titanium, are different from titanium-based alloys such as those described by Kalin, as demonstrated by a brief review of some of the references disclosed in the Information Disclosure Statement submitted herewith.

For example, E.P. George et al. in "Ordered Intermetallics," set forth the following definition of intermetallics: "ordered intermetallics....[are] a unique class of metallic materials that form long-range ordered crystal structures below a critical temperature in the solid state." This definition does not describe and cannot be used for titanium and its alloys. George et al. further state that titanium aluminides are part of the ordered intermetallics materials grouping, and that "some of these ordered intermetallics, especially those based on aluminides [which include the Ti-Al family] and silicides, possess many attractive properties for structural use at elevated temperatures in hostile environments. In general, the aluminides (and silicides) contain sufficient amounts of aluminium (or silicon) to form – in oxidizing environments – oxides scales that are often compact and protective." These statements do not describe and cannot be used for titanium and its alloys.

Similarly, D.M. Dimiduck et al. in "Intermetallic Materials for Aerospace Systems---An Overview of Development," state that: "...Titanium-based alloys have been critical to the achievement of supersonic flight... However, when new materials such as the intermetallic alloys are introduced as the basis for the next advance, they bring with them a completely new balance of properties...." *Id.* at p. 145 (emphasis added).

Similarly, D. Eylon et al. in "Titanium Alloys for High Temp Applications—A Review," state that: "Existing high temp Titanium alloys are based on high alpha phase volume fraction morphology....". *Id.* at p. 82. It is well known, however, that titanium aluminides are not based on high alpha phase volume fraction morphology, and titanium aluminides are materials useful for high temperature applications. Accordingly, it is clear that even the Eylon reference considers titanium aluminides to be different from titanium or titanium-based alloys.

Similarly, A.F. Giamei in "Intermetallics" states that: "Intermetallic compounds and alloys have great potential in structural engineering applications, especially at high temperatures...." *Id.* at p. 35. Giamei provide examples of the intermetallics to include "new alloys, such as TiAl, Ti_3Al, FeAl, NiAl, Nb_3Al and $MoSi_2$ – [which] have good mechanical properties and/or environmental resistance...." *Id.* Giamei also states that "Overall, intermetallic compounds have... brittleness... The same strong bonding that makes the[se] materials ordered and strong makes them brittle...." *Id.* In contrast, it is well known that titanium and titanium-based alloys such as the alloys described by Kalin do not exhibit the same brittleness as do intermetallic alloys.

The fact that titanium aluminides and titanium-based alloys are different materials is also emphasized in S.L. Semiatin et al., "Hot Workability of Titanium and Titanium Aluminide Alloys---An Overview." In particular, the authors in the introductory section of this reference state that "[t]he discussion will cover both conventional titanium alloys (principally α/β alloys) as well as the intermetallic titanium aluminide alloys (principally the near-γ titanium aluminide materials)." *Id.* at p. 2 (emphasis added). This statement clearly indicates that, to one skilled in the art, a conventional titanium alloy, such as the alloy of Kalin, is different from an intermetallic titanium aluminide alloy.

D. Eylon and S.R. Seagle, in "Titanium Technology in the USA—An Overview," do not expressly distinguish between titanium alloys and titanium aluminides (*see* p. 440). However, Table 1, p. 442 of the Eylon and Seagle reference lists only conventional titanium alloys and no titanium aluminides.

Accordingly, it is clear from a review of the foregoing references that one skilled in the art would understand a titanium aluminide to be an intermetallic compound and therefore to differ from a titanium-based alloy such as those described by Kalin. Therefore, it is respectfully submitted that Claims 1 and 16 as amended (and Claims 2-15 and 17-30 depending on Claims 1 and 16, respectively) are not anticipated by Kalin. In view of the foregoing, withdrawal of the rejection of Claims 1-30 under 35 U.S.C. § 102(b) as anticipated by Kalin is respectfully requested.

Claims 1-5, 10-16, 20 and 25-30 have been rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 3,981,429 (Parker). Parker teaches a method for joining Titanium alloys known as Liquid Interface Diffusion (LID) Bonding using a LID interlayer of Cu and Ni. The Examiner takes the position that the disclosure of Parker meets the limitations recited in the Claims 1-5, 10-16, 20 and 25-30.

However, it is respectfully submitted that Claims 1-5, 10-16, 20 and 25-30 are not anticipated by Parker. As previously discussed, Claims 1 and 16 are directed to a titanium aluminide in which the braze foil contains copper, titanium, zirconium and optionally nickel. In contrast, Parker is directed to titanium alloys (*see, e.g.*, Abstract, and Col. 1, lines 43-45). Parker does not disclose or suggest titanium aluminides. As previously discussed, a titanium aluminide is different from a titanium alloy. Moreover, Claim 16 is directed to a <u>diffusion brazing</u> method (emphasis added), and Claim 1 as amended is directed to a structure prepared by a diffusion

brazing method. It is respectfully submitted that the amendment to Claim 1 is supported by the specification as originally filed (*see, e.g.*, p. 5, lines 2-6 of the Specification, and Claim 16) and therefore does not constitute new matter. In contrast, as also acknowledged by the Examiner, Parker discloses a liquid interface diffusion ("LID") bonding method (*see, e.g.*, specification, Col. 1, lines 51-61, and Title). Parker does not disclose or suggest a diffusion brazing method or a structure made by a diffusion brazing method. It is respectfully submitted that it is well known in the art that LID and diffusion brazing are different methods which result in the formation of different structures when a foil containing copper, titanium, and nickel is used. In particular, the Examiner is respectfully referred to the reference titled "Diffusion Brazing of a Ti-45Al-2Nb-2Mn+0.8vol% TiB_2 XD Alloy," *Proceeding of the Structural Intermetallics*, 1997, pp. 323-329, by Xu et al. (Xu et al.), disclosed in the Information Disclosure Statement submitted herewith. As noted in Xu et al., "the Cu-Ni TLP alloy is not a suitable filler metal for joining the γ-TiAl alloy to itself." *Id.* at p. 324. It is respectfully submitted that it is well understood to one of ordinary skill in the art that LID is a type of TLP, which is also known as ADB ("Activated Diffusion Bonding"). The Examiner is also respectfully referred to the enclosed Table titled "Matrix Summary of the Bond Joint Characteristics of the Two Different Brazing Techniques for Reactive Metals," disclosed in the Information Disclosure Statement submitted herewith, which illustrate the differences between diffusion brazing and LID used to braze reactive metals. In contrast, Xu et al. discloses a diffusion brazing method for joining γ-TiAl aluminide material to itself using a braze foil containing titanium, copper and nickel.

Furthermore, Parker does not disclose that the foil may contain zirconium. Accordingly, it is clear that Parker, which is directed to titanium-based alloys and to LID, does not anticipate the invention claimed in Claims 1 and 16 as amended (and Claims 2-5, 10-15, 20

and 25-30 ultimately dependent thereon), which are directed to a titanium aluminide and to a diffusion brazing method, and in which the foil contains titanium, copper, zirconium and optionally nickel. In view of the foregoing, withdrawal of the rejection of Claims 1-5, 10-16, 20 and 25-30 under 35 U.S.C. § 102(b) as anticipated by Parker is respectfully requested.

Claims 1-5, 10-16, 20 and 25-30 have been rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 4,869,421 (Norris). According to the Examiner, Parker teaches a method for jointing titanium aluminide structure (Official Action, p. 5, line 17). The Examiner further takes the position that the disclosure of Norris meets the limitations recited in Claims 1-5, 10-16, 20 and 25-30.

However, it is respectfully submitted that Claims 1-5, 10-16, 20 and 25-30 are not anticipated by Norris. As previously discussed, Claims 1 and 16 are directed to a structure prepared by a diffusion brazing method and a diffusion brazing method, respectively, in which the foil contains titanium, copper, zirconium and optionally nickel. In contrast, Norris discloses a LID bonding method (*see, e.g.*, col. 2, lines 21-23). Norris does not disclose or suggest a diffusion brazing method or a structure made by a diffusion brazing method. As discussed above in connection with the rejection of Claims 1-5, 10-16, 20 and 25-30 in view of Parker, it is well known in the art that LID Bonding and diffusion brazing are different brazing methods used for reactive metals. As previously noted, the differences in the two brazing methods are described in the enclosed Table disclosed in the Information Disclosure Statement submitted herewith.

Furthermore, Claims 1 and 16 as amended expressly recite a foil containing titanium, copper, zirconium and optionally nickel. In contrast, the interlayer of Norris et al. is an interlayer consisting essentially of copper and nickel (*see, e.g.*, Abstract and Col. 2, lines 66-67 of Norris et al.), and therefore differs from the foil of Claims 1 and 16 as amended.

Accordingly, Norris (which is directed to LID and requires a foil consisting essentially of copper and nickel) does not anticipate the invention claimed in Claims 1 and 16 as amended (and Claims 2-5, 10-15, 20 and 25-30 ultimately dependent thereon), which recite a diffusion brazing method and a foil containing titanium, copper, zirconium and optionally nickel. In view of the foregoing, withdrawal of the rejection of Claims 1-5, 10-16, 20 and 25-30 under 35 U.S.C. § 102(b) as anticipated by Norris is respectfully requested.

New Claims 31 and 34 have been added to further claim the invention. Independent Claims 31 and 32 are directed to a structure prepared by a method, and a method, respectively, in which the method comprises providing an orthorhombic Ti-Al alloy honeycomb core having a faying surface and at least one Ti-Al alloy facing sheet having a faying surface. It is respectfully submitted that the amendment is supported by the specification as originally filed (*see, e.g.*, Specification, p. 6, lines 1-4 and 8-12) and therefore does not constitute new matter. It is further respectfully submitted that new Claims 31-34 are novel and nonobvious over the cited references.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

____

Gary M. Butter
Patent Office Reg. No. 33,841

Andrea Dorigo
Patent Office Reg. No. 47,532

30 Rockefeller Plaza
New York, New York 10112-4498
Attorneys for Applicant
(212) 408-2500

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Claims 1 and 16 have been amended as follows:

1. (Amended) A titanium aluminide (Ti-Al) alloy honeycomb panel structure prepared by a diffusion brazing method comprising:

(a) providing Ti-Al alloy honeycomb core having a faying surface and at least one Ti-Al alloy facing sheet having a faying surface;

(b) contacting said honeycomb core faying surface and said at least one facing sheet faying surface, and positioning therebetween a metal braze filler foil containing copper, titanium, zirconium and optionally nickel, to form a braze assembly;

(c) subjecting said braze assembly to sufficient positive pressure to maintain position and alignment for joining; and

(d) heating said braze assembly for a sufficient amount of time to join said honeycomb core with said at least one facing sheet.

16. (Amended) A diffusion braz[e]ing method comprising:

(a) providing a Ti-Al alloy honeycomb core having a faying surface and at least one Ti-Al alloy facing sheet having a faying surface;

(b) contacting said honeycomb core faying surface and said at least one facing sheet faying surface, and positioning therebetween a metal braze filler foil containing copper, titanium, zirconium and optionally nickel, to form a braze assembly;

(c) subjecting said braze assembly to sufficient positive pressure to maintain position and alignment for joining; and

(d) heating said braze assembly for a sufficient amount of time to join said honeycomb core with said at least one facing sheet to form a titanium aluminide structure.

New Claims 31-34 have been added.